Duncan, W.S. The fossil antecedents of man. (1883)

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THE FOSSIL ANTECEDENTS OF MAN, AND WHERE TO DISCOVER THEM.

MUS.COMP.ZOOLOGY CAMBRIDGE MASS.

ILLUSTRATED.

BY

W. S. DUNCAN, M.A.I.

LONDON:
HARRISON & SONS, ST. MARTIN'S LANE,
Printers in Ordinary to Her Majesty.
1885.

(*Copies of this may be obtained of the Author* : ~~79, *Wolverhampton Road*, *Stafford*~~).

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PREFACE.

My object in publishing these papers is to awaken or stimulate interest in the practical solution of the problem of man's origin.

Readers in this country, who may see cogency in the arguments here advanced, are requested to indicate their willingness to contribute towards a fund for prosecuting the desired inquiry in the Region of Man's Evolution herein described.

The interest of readers abroad, who happen to be permanently or temporarily located in the region referred to, is respectfully solicited in view of their assisting in, or inducing others to lend their services to, the conduct of exploration.

W. S. Duncan.

79, Wolverhampton Road,
Stafford.

THE ANTECEDENTS OF MAN.

PHYSICAL ANTHROPOLOGY, OR THE SCIENCE OF MAN'S BODILY STRUCTURE.

Its Nature, Object, and Early Difficulties.

THE department of zoology designated "Anthropology" professes to investigate the relations subsisting between the different races of mankind, and between man and the animals nearest to him. This it does by following the ordinary rules of study in natural history—viz., by carefully comparing and contrasting individuals as respects their bodily structures, and their organic functions or habits, then putting the results in tabular form for ready reference.

The admittedly wide gap between man and the apes, which of all animals come nearest to him, had inspired earlier zoologists with a suspicion that not much advancement could be gained by comparing man with them, or by comparing them with man. This, together with the fear that religious interests seemed to require the subject to be shunned, prevented anthropology from developing into a special department of zoology.

The progress of science generally, however, involved the advancement of the science of man in his zoological relations as an absolute necessity. Geology had survived the *odium theologicum;* so had astronomy. Why should not anthropology? Palæontology had filled up many gaps among the lower animals; was it not possible that the hiatus between man and the anthropoid apes might some day be bridged?

Timidly and amidst much persecution did individual zoologists patiently pursue this special line of study, till at length, their numbers increasing, they united in societies for the purpose of communicating to one another their discoveries, comparing, criticising, and correcting their results. Now there are to be found Anthropological Societies in England, America, France, Spain, Germany, Russia, and Italy, and the science may be said to be steadily gaining ground, both in the appreciation of the educated and in the material progress of its research. Like every other branch of science it has to pass through the groping and blundering stage up to the intelligent and accurate, or, in other words, the truly scientific stage. Many old methods of investigation have had to be abandoned for their inaccuracies. Newer and better methods have been adopted in their stead, and the science is steadily rising from an empirical to a scientific platform.

Its Method.—Comparison.

Anthropology must begin by comparing man with the lowest animals, or rather the lowest forms of life, be they animal or vegetable.

Evidence from the Stages of Development of the Human Individual.

The human animal, then, in common with the lowest organisms, must originate in an ovum, or egg. In the compass of a spherical bag, with semi-fluid contents, and measuring not more than 120th of an inch in diameter, lies the elements of that wonderful being, Man, the lord of creation!

The ovum, fertilised and supplied with nourishment, grows or increases in bulk, and divides and subdivides its substance into a mass of cellular tissue after the same manner as a plant. The tissue at length, instinct with life, becomes depressed so as to form a groove, the future seat of the spinal cord and brain. The edges of this groove curl up, meet and unite, and the cerebro-spinal tube is formed. The same happens on the other side of the ovum—a tube becomes formed by the curving under of the rest of the egg-tissue till they meet and unite. Thus the future animal consists simply of a double tube. The walls of these tubes originate next by an alteration of their character here and there, called "differentiation," the various structures which they are destined to enclose and protect, namely, the spinal cord and brain in the posterior tube, and the heart, lungs, and abdominal viscera in the front tube; while the partition dividing the one tube from the other is the seat of the bony structure which distinguishes him as belonging to the category of vertebrate animals.

Without entering into all the minutiæ of development, it may be stated that the various stages through which his frame passes during embryonic development are remarkable for their analogy to conditions of organisation at which animals lower in the scale have been arrested. Thus, for example, his skeleton is first fibrous, or cartilaginous, a condition which the lowest members of the vertebrate kingdom never get beyond, namely, Amphioxus, or the Lancelot, and the Lamprey. His brain gets sketched out as theirs into three parts—fore-brain, mid-brain, and hind-brain. His heart, also, like theirs, starts as a single chamber, or swelling upon a tube. In his neck there are found apertures, or slits which are in him never turned to account, but which in the skates, sharks, and dogfish develop gills, and continue to remain open. The same gill-slits exist in the amphibia, namely, in the frogs, newts, and salamanders, during their early stage of development, but ultimately get closed, as in man and all intermediate animals. The fish-like heart of the human organism, first single, then double, next assumes the reptilian character of being three-chambered. The skeleton gradually advances from the cartilaginous to the osseous, with elements at first characteristic of all the vertebrata, then becoming more and more specialised in structure. "At the fourth week," says Topinard, "the difference between the man and the dog is inappreciable. The divergence only commences in earnest at the eighth week."

The skulls of the higher vertebrates (man included) in the course of their development, are found to pass through stages substantially similar to those at which lower vertebrates are arrested. And the bones composing the skull in higher vertebrates are found to correspond generally with those in lower vertebrates by the position they occupy with reference to the nerves sent out from the brain to the organs of special sense—smell, sight, hearing, &c.

The elements of the vertebral column and limbs similarly correspond generally in man and the higher vertebrates with the lower vertebrates, as far down even as the amphibia.

The chief modifications of the brain arise from the development of the hemispheres in relation to the other parts. The cerebral hemispheres, which are developed from the fore-brain, remain small in the lower vertebrates, while in the higher they generally increase with the ascending status of the animal, extending backward and downward, till at last, in man, they conceal the base of the brain. Moreover, the growth of the hemispheres so outstrips the growth of the skull that the surface of the hemispheres becomes dimpled, then furrowed or wrinkled, which wrinkles become more and more deep and complex as they approach near to man, in whom it is the most distinguishing characteristic, alike for its enormous size and weight, and the intelligence of which it is the organ.

So thoroughly similar in character are the elements of which the brain is made up in the higher vertebrates to that found in the lower, that, notwithstanding the many gaps in other respects dividing animals from each other, a gradation of development is established, which of itself would give presumptive proof of the derivation or evolution of the higher vertebrates from the lower. In vain has it been attempted to discover in the structure of the human brain something which was not found in those of the animals nearest to him. The elements are all the same; the difference merely consists in the greater development of the hemispheres relative to the rest of the brain—a mere question of the bulk of the thinking organ.

Of all the vertebrate animals the brain of the man-like apes comes nearest to man, both in bulk and appearance. The elements are all the same; the very convolutions, or furrows, are substantially the same, except that they are more symmetrical in the ape's brain than in man's. But there is a difference in bulk between the brain of man and his nearest relations which separates them by a chasm that remains yet to be filled up if man's origin by derivation from the lower animals is ever to be settled beyond dispute.

On this point the celebrated French anthropologist says: "There seems to us to be a very fundamental distinction between man and the animal most nearly resembling him. We have three or four times more brain, three or four times more thinking material. The supremacy which our very exalted intellectual faculties secure to us is confirmed to us by an exceptional development of the organ which is its seat. Anatomy furnishes us at the outset with powerful characters sufficient to satisfy the most jealous defenders of human prerogative, and to console them under the difficulties they will meet with in matters of minor importance."

MAN COMPARED WITH APES AND MONKEYS.

The Skeleton.

Having made this candid statement with respect to the relative bulks of the human and the ape brain, it is now necessary to examine the points of comparison between man and ape, and between both and the lower monkeys and quadrupeds, in those matters or points of "minor importance"—the general structure of his skeleton.

The Vertebral Column.

The vertebral column is made up of segments consisting generally of flat discs, with ring-like and more or less straight offshoots, called processes. The ring-like branches of the flat discs enclose the spinal cord; the straight processes are for the attachment of muscles. These segments, together with their straight and ring-like processes, are termed vertebræ. Most of them are separated from one another by a tough but semi-elastic substance—indeed, all are so separated in the earlier stages of development, but as growth proceeds some of the vertebræ get welded into one by the ossification of the intervertebral substance, as in the vertebræ that go to support the pelvis, namely, the sacral vertebræ. The column is divided into a cervical or neck portion, a dorsal or back portion, to which ribs are joined, a lumbar or loin region, a sacral or pelvic region, and, lastly, a coccygeal or tail region.

Let us now see wherein there is agreement or difference between man and the lower animals in respect of the constituents of the spinal column.

In man the number of vertebræ in the entire column is usually 33, though sometimes there are 34. In the three higher apes, the gorilla, the chimpanzee, and the orang, the number of vertebræ is the same as in man, namely, 33. In the lowest ape, the gibbon, the number is 35. There are 7 neck vertebræ in man and apes alike. The spinous processes attached to these neck vertebræ are simple in all the apes and monkeys except the chimpanzee, which has two out of the seven presenting a characteristic peculiar to the cervical vertebræ of man, the processes being split into two branches, or forked.

The number of the vertebræ in the back and loins is from 19 to 24 in the inferior monkeys; 18 in the lowest ape; 17 in the chimpanzee and gorilla, which is the usual number in man.

The spinous processes of the vertebræ in the lumbar region are all turned forward, or "anteverted," in the inferior monkeys and quadrupeds, as a condition of their having to walk on all fours; while the corresponding processes in the region of the back are turned tailwards, or "retroverted." Now in none of the apes are the lumbar spinous processes anteverted in the least, but approach very near to man, in whom the spinous processes of all the dorso-lumbar vertebræ are retroverted—essential conditions of the erect or semi-erect attitude in progression.

The sacral vertebræ are in the lower monkeys from 5 to 7; in all the apes there are 5 as in man. Though these 5 vertebræ are all welded together to support the viscera in the erect attitude, yet only 3 are *true* sacral in the sense of giving attachment to the pelvic girdle. The other two are, properly speaking, caudal vertebræ.

The true sacral vertebræ, then, are three in number, the same as are found in all the apes and even the inferior monkeys. The apes agree with man in having two false sacral vertebræ, forming really part of the caudal region.

The caudal vertebræ have been divided into true and false; the true are those into which the spinal canal is continued, or those remaining vertebræ posterior to the sacral, which have rudimentary rings; the false caudal vertebræ are those into which the spinal canal is not continued, but simply consist of button-like segments.

The number of true caudal vertebræ in the inferior monkeys is from 5 to 7, in the apes, and in man only 2. The number of false vertebræ in the tail is from 4 to 26 in the lower monkeys, while in the apes it is from 4 to 5. In man the number is 4. The true and false vertebræ in the tail of the lower monkeys is thus from 9 to 33. In the apes it is from 6 to 8. In man from 6 to 7, but usually 6.

Man and the apes agree in having a tail about the same length, which, like the hind limbs of some whales, never, or very rarely, comes out to the surface, but is utilised for the support of the viscera in the upright posture. Or, if it be desirable to repudiate man's possession of a tail, then the same compliment—if it be a compliment—must be paid to all the apes, namely, the gibbon, the orang, the chimpanzee, and gorilla.

The Thorax.

Concerning the Thorax, it is composed of 11 to 15 pairs of ribs in the inferior monkeys; 13 pairs in the lowest ape and in the chimpanzee and gorilla; 12 pairs in the orang and in man, though in some cases there are 13 pairs in man.

The chest in the inferior monkey is widest from back to front. In the apes it is widest from side to side; and this is also the case with man. The breastbone is flat in man and the apes, while in the inferior monkeys it is only flat at the top.

The Pelvis.

There is also a noteworthy approximation to man in the proportions of the pelvis in apes. While the quadrupeds, inferior monkeys, and lowest apes have the pelvis longer than it is broad, the breadth exceeds the length in the three highest apes as in man.

The Extremities.[1]

If the thigh and leg bones be supposed divided into 100 parts the proportion of the arm and fore-arm are as follows:—In the orang, 140·4; the chimpanzee, 108·2; the gorilla, 101·3; in man, 68·9. Thus it will be seen that while in man the upper extremities are shorter than the lower; in the gorilla they are equal; in the chimpanzee they are a little longer; while in the orang they are considerably longer. In the gibbon, it may be remarked, they are longest of all. Thus the gorilla comes nearest to man in the proportion of the upper to the lower limbs.

If the fore-arm be similarly compared with the arm by supposing the humerus divided into 100 parts, then the radius is 100 in the orang; 90·1 in the chimpanzee; 77·1 in the gorilla; and 75·1 in man. Here, again, the gorilla comes nearest to man.

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[1] The measurements here given are averages extracted from Topinard's "Anthropology," translated by Dr. Bartley. (Chapman & Hall.)

Again, if the leg be compared with the thigh, supposing the femur divided into 100 parts, then the tibia in the orang would measure 86·6 of these parts, the chimpanzee and gorilla 84·5, man 82·6.

The arm compared with the thigh is 131·6 in the orang; 110·2 in the gorilla; 90·8 in the chimpanzee; and 71·1 in man. Here the chimpanzee, and not the gorilla, comes nearest to man.

If the length of the hand, compared wlth the height, be now examined, it is 20·3 in the orang; 18 in the chimpanzee; 14·54 in the gorilla; and 11·82 in man.

Next the foot, if compared with the stature, is 25·00 in orang; 21·00 in chimpanzee; 20·69 in gorilla; and 16·96 in man.

We thus see that generally there is an increasing nearness to man in the proportion of the parts of the extremities to one another and to the stature as we pass from the orang to the gorilla. The stature also increases in the same rotation. Being 3 feet only in the lowest ape, the gibbon; it is 4 feet in the orang; a little more in the chimpanzee; 5 to 5½ feet in the gorilla, which is quite as tall as many men.

The apes and man can alone rotate the hand from palm downwards to palm upwards without moving the elbow.

The Hand and Foot.

If we compare the hand with the foot of the ape we certainly seem to see a fundamental difference between them and man in the hand-like aspect of the foot. Still, although the foot of an ape can grasp more readily than a human foot, yet the principle by which this is done in apes does not differ from that adopted by some Negroes, Chinese oarsmen, and Nubian horsemen. The great toe even in the apes cannot be used in opposition to the lesser toes, as the thumb is opposed to the fingers, so as to seize small objects. Therefore the hind foot of the ape is not a hand, and the apes cannot properly be called quadrumana. They are *bi*-mana equally with man, though from having an arboreal life they use the foot more in grasping than any man does.

The Nails.

Among the minor points of resemblance to man may be mentioned the fact that no animals except the apes have their nails flat, as man. The lowest ape has, however, only the thumb and great toe flat-nailed—in keeping with the transitional characters of this ape in many other features; the three higher apes have all their nails flat.

THE SKULL.

The Jaws.

But we have one most important inquiry yet to prosecute, and that is the comparison of the skull in apes with that of man. Beginning with the anatomy of the facial portion, it may be observed that the jaws are long and narrow, or dog-like, in the inferior monkeys; shorter in apes, though still very prognathous; shorter still, considerably, in even the lowest races of mankind, in whom, however, the jaws protrude considerably as in Negritos in Java, Andamanese, African Negroes, and Australian Aborigines. In the higher races of mankind the jaws are shorter and more arched, and assume the form which has been called orthogoathous.

The lower jaw in the higher races of man has a prominent chin, which is almost absent in the lower races, and is obsolete entirely in apes.

The Teeth.

The teeth in man and apes are the same in number, namely, eight on each side in both jaws. The apes, generally, have the canine teeth large and strong, and separated from their neighbouring teeth, the incisors or pre-molars, by a space, to permit the one canine tooth to pass the other. This space is called a diastema. All the apes have a considerable diastema except the female chimpanzee and a species of orang in Borneo, in whom it is small, because they have small canines.[1] These characteristics in the face of apes—their prognathism and the prominence of their canine teeth—have all relation to their rapacious and warlike propensities, and to the nature of their food. Even in the higher races of man, however, the prominence and projection of the canines beyond the level of the other teeth is often remarkable.

The molars, or back grinding teeth, in apes are the same in pattern as those of man. In man the last molar, or "wisdom tooth," is smaller than the other molars; so is it with the chimpanzee and orang, and with the fossil *Palæopithecus*, found in Northern India; but not so with the gorilla, in which it is larger. In succession, the grinders are, in the apes, cut before the incisors. With man the converse is the case.[2] The inner upper, and outer lower incisors are wider than their neighbouring incisors, both in apes and man.

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[1] Owen's "Odontography," text p. 444, Pl. 117, fig. 4.

[2] Professor Owen, in "Longmans' Magazine" for November, 1882.

The Cranium.

We come now to consider the brain case. The largest cranial capacity of an ape is 623 cubic centimetres, as measured by Topinard. The smallest human cranium measured by Professor Flower, and that of an adult female of the tribe called Veddahs, inhabiting a mountain in Ceylon, is 960 centimetres. So that the lowest human cranium yet found exceeds the highest ape cranium by about one-third. Professor Flower's next lowest are those of Andamanese, in whom the cranial capacity is 1,184 centimetres, about double that of the ape referred to. The Andamanese, however, as also the Veddahs, are very diminutive people, and, therefore, their crania are necessarily proportionately small. Australian Aborigines, however, are not small in stature, and, therefore, the capacity of their crania may be cited as that of the lowest human types, namely, 1,259 centimetres. This is considerably larger than double of the highest ape. And from this cranial capacity there are all degrees of development up to about 1,600 cubic centimetres in European races.

The occipital foramen, or opening upon the base of the skull, where the spinal cord enters, is in the apes situated far to the rear, while in highly-developed human skulls it is almost central. In low types of human skulls its position so far resembles that of the apes as to be situated considerably behind the centre.

There are the same number of bones in the skulls of apes and monkeys as in those of man, and the general character of these is the same in both, but there are differences arising from the degree of development of these in relation to one another. Not only is this the case with regard to the bones of the face, but to those of the cranium, or brain-case. For example, some of the ape skulls have enormous brow-ridges, ridges along the middle line of the crown and across the skull in the occipital region. These ridges are for the attachment of strong jaw and neck muscles, and are absent in the human skull, though the representatives of some of them are there. Remarkably well-developed brow-ridges are seen on some of the lowest types of human skulls, as, for instance, that found in the Neanderthal cave, Dusseldorf; also the skull from the Engis cave near Liége. Then the crest on the middle line of the gorilla's skull, called the sagittal crest, is represented by the two temporal ridges on either side of the human skull, which form the origin of the same jaw muscles as does the sagittal crest of the gorilla and dog. The occipital crest of the ape and dog has its counterpart in the human skull, in the shape of the occipital protuberance, or inion, which in some inferior types is large and conspicuous, though in every case much dwarfed as compared with the skulls of the apes, which have the occipital ridge.

In the adjoining plate I have figured the skulls of the three higher apes—the gorilla, chimpanzee, and orang.

The gorilla, it will be seen, has all three ridges enormously developed; the orang has only the occipital ridge conspicuous, the brow-ridge being comparatively slight; the chimpanzee has neither the sagittal nor occipital ridges, and has the brow-ridge much less prominent than the gorilla, though much more conspicuous than the orang.

Application of the Foregoing Facts of Comparison.

Having now rapidly compared the human skeleton with that of those animals most nearly allied to man in their salient features, I need hardly say that anthropologists, in tracing out distinctions of race, and in noting degrees of inferiority between one race of mankind and another, consider those races as the most inferior which exhibit most emphatically the structural characteristics of the apes, monkeys, or quadrupeds.

Now, as the great superiority of the human organisation consists in the greater development of the brain, the skull is the structure in human beings of chief interest in an anatomical comparison with the lower animals.

Physical anthropology, therefore, concerns itself very much with degrees of craniological development, as the shape and size of the brain-case, the prominence or otherwise of the brow-ridge, the temporal-ridges, or occipital protuberance, the lengths or directions of sutures between the bones composing the cranium, the position of the occipital foramen, and such-like features. Then, anthropology considers, with regard to the bones of the face, the degree of prognathism, the degree of development of the chin prominence, whether tending to obliteration, as in apes, or not; the form of the alveolar arches, the size of the canine teeth, the proportions between the horizontal and upright parts of the lower jaw, &c., &c,—in short, all those features that are on the one hand most human, or on the other hand most simian.[1]

Locality of the Lowest Living Races.

Anthropological science has succeeded in proving that, of the human races now living, the lowest known are those occupying inter-tropical Africa, Eastern Asia, the Malay-Archipelago, the Pacific Islands, and Australia, for these have at once the greatest degree of prognathism and the smallest brains.

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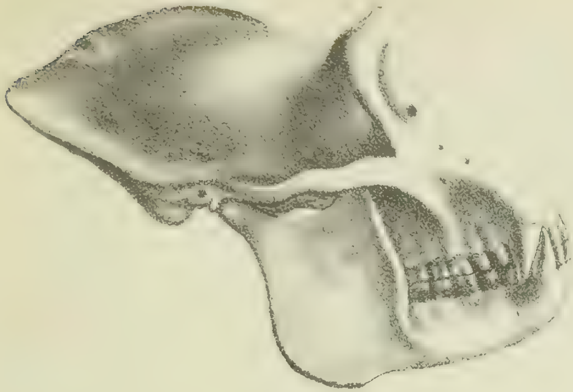
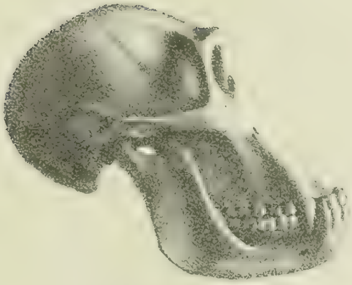
[1] The expansion of this subject by a new deductive method is at present occupying my attention. Appended to this paper is a brief statement of the method.

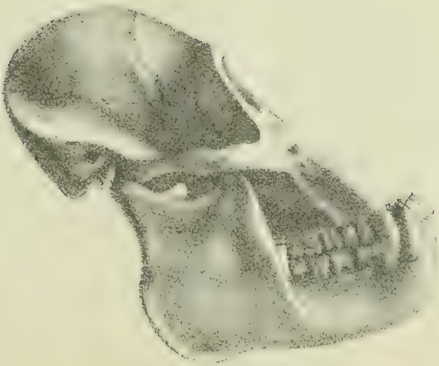
SKULLS OF ANTHROPOID APES. ¼ FULL SIZE.



GORILLA.



CHIMPANZEE.



ORANG.

Ancient Human Remains.

Complete human skeletons of great antiquity have not been discovered in very great numbers, and those discovered are not stated to have been very markedly approximate to those of the apes or other animals. Skulls have been found, however, in greater number than full skeletons, and degrees of inferiority have in their case been noted greatest in those of greatest antiquity.

Second, the oldest human skulls, that is, those found lowest down in the drift and cave deposits, are found to be the most simian in their character. The jaws are most prognathous; the lower jaw is most deficient of the chin prominence; the foreheads are most receding, and the brow-ridges most developed, and the crania have on the whole the smallest capacity.

In England the ancient human remains found are of two classes—namely, those discovered in round barrows and those in long barrows. Those found in round barrows are of a mixed kind, being partly brachycephalic or broad-headed, and partly dolicocephalic, or narrow-headed, and are accompanied by metal. The long barrows contain polished stone implements and skulls for the most part thoroughly dolicocephalic. These latter are described as prehistoric, and as belonging to the Neolithic age. The Neanderthal skull before referred to belonged to the rough stone epoch, when man's weapons were but rude, unpolished flint chips. This is called the Palæolithic age, when man was contemporary with the mammoth. He has left us traces of his artistic powers in the shape of sketches of animal forms on bones and on ivory.

As yet anthropology has found nothing lower than the skull of the Neanderthal man of the mammoth epoch; and though this is plainly a long way towards a simian type, it must be admitted that many links will require to be found before the simian origin of man be placed upon a demonstrative basis like that which has been laid in the case of the horse.

But does the mere absence of these links between man and the animals thus shown so closely related to him compel us to believe that transitional links never existed? Certainly not; for as previously existing gaps have already been filled up between more widely divergent types in the case of the lower animals than exist between man and apes, so we may rest assured "missing links" exhibiting the transitional or pithecoid form will yet be found.

Why, it may be asked, have these links as yet remained unearthed?

To this I reply, because the quarter in which they are most likely to be found is the very region which has been as yet least explored. This leads me to speak of the probable time, place, and manner of the evolution of man, which will form the subject of the next paper.

DEDUCTIVE CRANIOLOGY.

Just as the structure of the limb bones of the horse have suggested that of the limbs of its ancestor, so a study of the human skull, in its various race-types, may, in my opinion, suggest the pedigree of the race to which a given human skull belongs.

At least a comparison of the projection-outlines of skulls similarly posed and assimilated to one standard of measurement, has enabled me to construct a series of intermediate forms between ape skulls and human skulls, taken respectively as the extremes of a type having certain broad characteristics in common.

Posing the skulls so that the basi-alveolar line is horizontal, I make careful projection-outlines. Then I enlarge or diminish the drawings so as to reduce them all to a uniform perpendicular height, from the glabella to the basi-alveolar line. I then superpose a tracing of an ape skull over the drawing of a human skull so that the lines in each, which represent the altitude of the glabella, shall coincide. This enables me to see whether the skulls are in any way resembling each other, while showing at a glance the relative prognathism and cranial development. This method enables me further to construct intermediate links to an almost unlimited extent, when the types of an ape and a human skull are found to resemble each other.

Plates are here given, illustrating the method and its results. The agreement between the orang and Andamanese skulls,[1] in comparative smoothness of forehead and great breadth in the occipital region, has seemed to warrant my use of the orang skull as a basis from which to deduce ancestral forms of the Andamanese skull. By this I do not wish to be understood as contending that the ancestors of the Andamanese were orangs, but merely to suggest that their skulls may have been orang-like in the characteristics above named.

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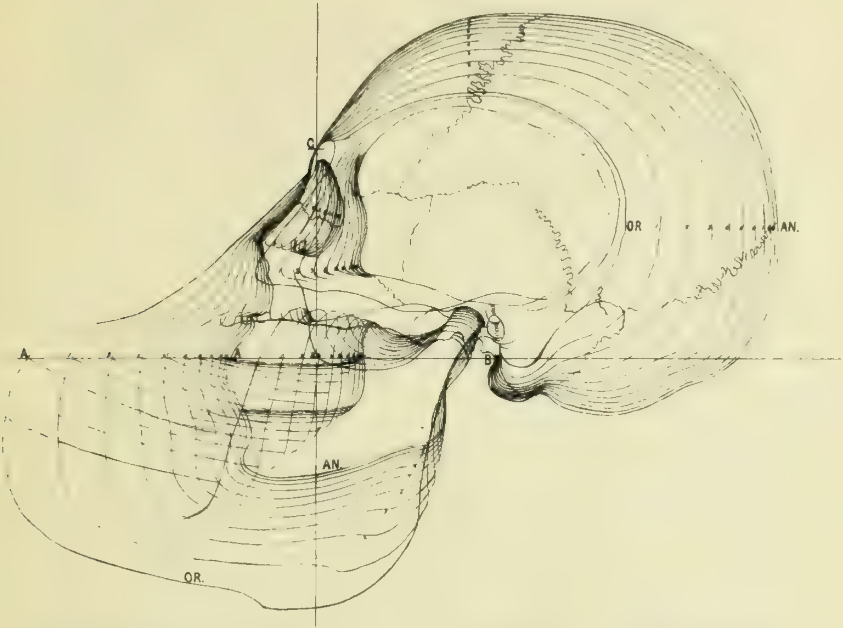
[1] The drawing of the Andamanese skull is copied from a plate in the "Journal of the Anthropological Institute" for November, 1879, in connection with Professor Flower's paper on "The Osteology and Affinities of the Natives of the Andaman Islands." The drawing of the orang's skull is taken from an actual specimen.

STAGES OF EVOLUTION OF THE ANDAMANESE SKULL FROM THE ORANG TYPE.



B, the Basion or point on base of skull on front edge of occipital foramen.

A, the Alveolar Point or middle and foremost point of upper jaw, between roots of middle upper incisors.

BA, the Basi-alveolar-line, or line joining Basion to Alveolar point.

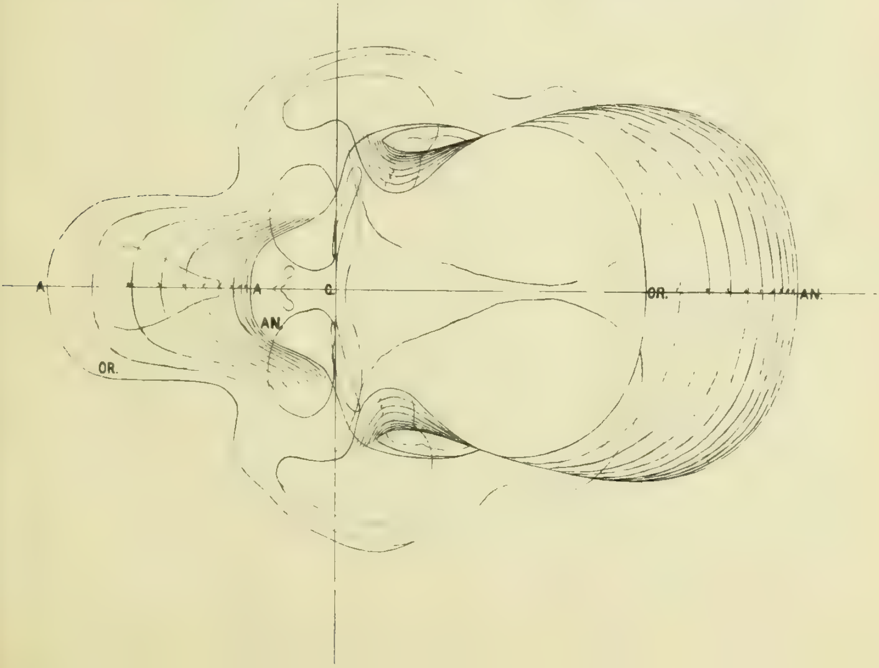
G, the Glabella or middle point of forehead, just between the ridges of the eyebrows

Ga, the Glabellar Altitude, or perpendicular height of Glabella above Basi-aveolar-line.

OR, the Contour of the Orang skull.

AN, the Contour of the Andamanese skull

1, 2, 3, &c., Contour links intervening between **OR** and **AN**.



The divisions made between the contour of the orang and that of the Andamanese skull, it will be seen, are in a decreasing ratio from left to right. But as *equal cranial* expansions would have increased superficial areas they would have diminished thicknesses, otherwise the cubic contents of such expansions would be unequal. The cranial divisions here given in a diminishing ratio may thus be taken to express *equal cranial enlargements.*

The same reasoning would apply to the jaws, and consequently equal degrees of jaw-diminution might have been expressed by a series of divisions diminishing from *right to left.* An equal division from A to A would express an *increase* in the rate of jaw-diminution. In the diagram the divisions decrease from left to right, and therefore the rate of jaw-diminution here given is a diminishing rate.

Taking the middle three of the links, namely, Nos. 4, 5, and 6, the crania of which are seen to be not very far from the human dimensions, the jaws are still wonderfully prognathous. Were the rate of jaw-diminution an increasing one they would be still more ape-like, ranging from beyond the jaws of No. 2 to under No. 3 in the diagram. Were the rate of jaw-diminution equal or *pari passu* with cranial enlargement, then the jaws would be exceedingly ape-like, ranging from beyond No. 1 to between Nos. 1 and 2 in the diagram.

We thus see that when fossils of ape-like jaws are found, it does not follow that they belong to true apes, as is concluded by Mr. Lydekker[1] in the case of *Palæopithecus,* which may after all belong to one of the "missing links"; as also may the fossil *Dryopithecus* found in the south of France, near the base of the Pyrenees. Indeed the more we consider the probabilities of the form the more we are compelled to believe that the majority of the transitional links must have been very prognathous.

As some people who have little faith in deductive methods may ask wherein lies the advantage of endeavouring to find out the forms of transitional links, I reply in anticipation that any discovery must surely be aided by a previous knowledge of what may reasonably be expected.

The deductive method here adopted I claim to be a sound one, and I have applied it further to the tracing of links between other types of ape and human skulls, but the limited compass of this *brochure* compels me to reserve the statement of my results for a future paper.

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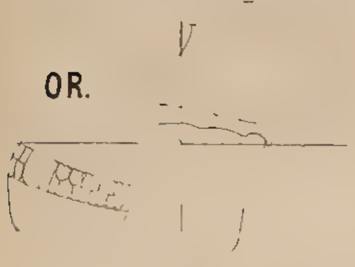
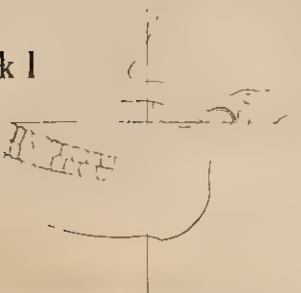
[1] "Records of Geological Survey of India," vol. xii, Part I, p. 36.

ORANG TYPE
TO
ANDAMANESE

OR.



Link 1



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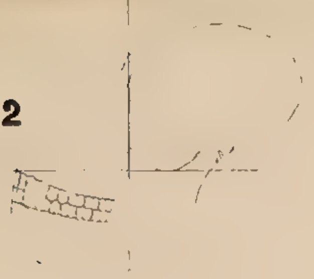

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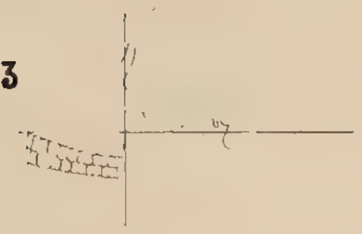

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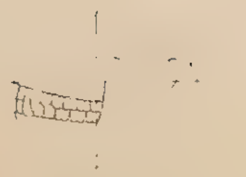

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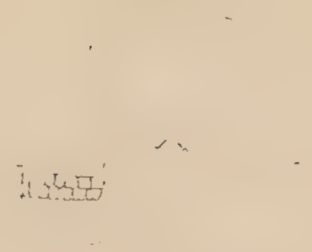

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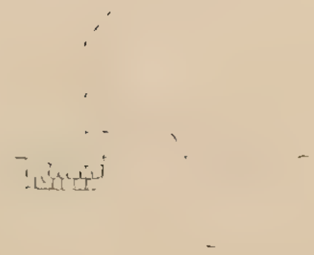

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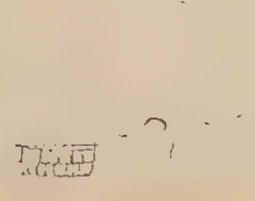

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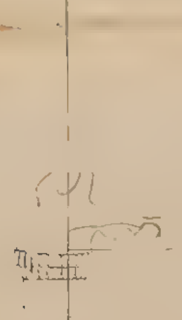

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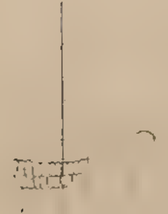
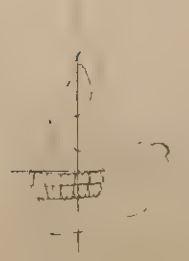


AN.



Read before the British Association Meeting, at Southampton, in August, 1882.

Read before the Anthropological Institute, London, 9th January, 1883.

Reprinted from the Anthropological Journal for May, 1883.

WHERE *to* DISCOVER *the* FOSSIL ANTECEDENTS *of* MAN; *or, The* PROBABLE REGION *of* MAN'S EVOLUTION.

ASSUMING that man was evolved from a form lower in organisation than that of the lowest type yet discovered, that his origination formed no exception to the general law of evolution recognised as accounting for the appearance of the lower forms of life, Man's most immediate ancestors must have been similar in structure to that of the existing anthropoid apes. Yet it is not necessary to suppose that any of the anthropoid apes at present existing belong to the same family as that of man. It is only indispensable to the hypothesis of man's evolution to say that man formed one at least of a set of families of man-like animals somewhat similar to the present apes. For in seeking for a transitional link between man and a lower form we naturally look for a structure having a smaller brain capacity, and a body less adapted to the upright posture. To seek for this is to search for a form more ape-like in all respects. As was admirably summarised by Darwin in his "Descent of Man" (p. 190), "Nearly all the more important differences between man and the quadrumana are manifestly adaptive in their nature, and relate chiefly to the erect position of man, such as the structure of the hand, foot, and pelvis, the curvature of the spine, and the position of his head." If, then, by palæontological evidence we can trace the changes through which the human form has passed from a semi-erect, quadrumanous, small-brained creature to an erect, large-brained biped, we shall have raised the doctrine of man's evolution from the low ground of hypothesis to the elevated platform of historical fact.

I shall now inquire what evidence, if any, we possess to lead us to hope for success in the search for fossil remains demonstrating the existence in past geological time of such transitional links.

The quarter from which our first ray of light comes is that of the science of distribution, or the compilation of facts which proves the geographical distribution, in present and past time, of the order *Primates* to which man belongs. According to the standard work of reference by Mr. A. R. Wallace, namely, his "Geographical Distribution of Animals," we learn that there is no evidence to show that any but the lowest families of the Primates—to wit, the Lemurs, and the lowest types of monkeys, were distributed to both the New and the Old World, man of course excepted. It is therefore probable that these families originated within the Arctic Circle so as to become easily distributed over both hemispheres; for their powers of locomotion are so limited, and their dependence on a warm climate where fruit-trees abound is so absolute, that the distribution of these animals from one hemisphere to another after they had passed south of the Arctic Circle is extremely improbable, if not altogether impossible. The least indispensable conditions under which animals, originated in either hemisphere south of the land passage between the two, could pass from one hemisphere to the other, must be that they should be compelled to accommodate themselves to lower temperatures, and to entirely new kinds of food. There is no evidence to show that either the lemurs or the lowest types of monkeys were compelled to fly northwards, and so to alter their habits and constitutions, and therefore we account for their existence in both hemispheres by supposing them to have been originated within the Arctic Circle at a period when that region was tropical.

But while it may safely be supposed that the lowest members of the Primates took origin in what is now the frigid zone, it cannot be deemed at all likely that the higher types of monkeys, much less the anthropoid apes, ever existed so far north. There is no evidence that they ever appeared in America, while they have been and still are distributed in the Old World. Had the higher monkeys, or the anthropoid apes, been evolved within the Arctic regions they would in all probability be found, living or fossil, in the New as well as in the Old World. Until any evidence is adduced that these higher families of the Primates were distributed to America it would be idle conjecture to suppose that they originated within the Arctic Circle; and if there is no evidence to show that these families took origin in that region it is infinitely less probable that the latest, highest, most specialised of all animals—man—began being in these remote regions. On the other hand, since only the lowest members of the Primates have been distributed to both eastern and western hemispheres, while the higher members exist abundantly in the Old World, these facts indicate emphatically that the higher primates were originated on this eastern hemisphere—and this, too, in a latitude so far south of the land connection between the two worlds that, for reasons already mentioned, it became impossible for them to enter afterwards the continent of America.

Again, the fact that man, in remote antiquity, became universally distributed only proves that at that distant epoch he had thoroughly acquired the necessary powers of locomotion, and of accommodating himself to varieties of climate, temperature, and food, which among other characteristics mark him off as an improved and highly specialised type. What we already know of distribution, then, points to this first important conclusion—that the higher primates, and therefore man, were not originated within the Arctic Circle, nor yet in the New World, but somewhere in the Old World alone.

Being now confined to the Old World in our quest for the remains of incipient man, let us next see whether we cannot get some definite evidence as to the locality in this hemisphere where his relics are to be found, still taking as our clue to search the known facts of distribution, in past and present time, of the monkeys and apes of the Old World, and beginning with the lowest family, according to Mr. Mivart's classification (which is adopted by Mr. Wallace): it is as follows:—

The *Cynopithecidæ*, or Old World monkeys of the dog-shaped type, have, according to evidence, lived during the middle and later Tertiary time in the south of England, the south of France, and in Northern India. At present they are found in Gibraltar, Northern, Western, Tropical, and Eastern Africa; they are also in Arabia, India, Eastern Thibet, Japan, and the Malay Islands, including the Phillipines and the Celebes. This goes to show that this, the lowest family of monkeys, has been distributed, since middle Tertiary time, from the west of Central Europe to Southern Europe and Eastern Asia, and from thence as far south as the tropics of Africa and Malaysia.

The next higher family of Simii, namely, the *Semnopithecidæ* have during the same middle and later Tertiary periods lived in Southern Germany and France, Italy, Greece, and Northern India. They are now found in Eastern and Western Africa, Indo-China, India, Ceylon, and Malaysia. Thus this family, which is intermediate between the lowest monkeys and the anthropoid apes, has, like the former, been dispersed from Central and Western Europe to Southern Europe and South-Eastern Asia, and thence down as far as about the Ethiopian and Oriental tropics.

As yet no evidence exists that the highest family of the Simii, namely, the anthropoid apes, ever had a range so far north as that of the Semnopithecidæ or the Cynopithecidæ. Of the man-shaped apes the lowest genus, *Siamanga*, has not as yet been found fossil: at present it ranges through Malacca and Sumatra. Remains of the genus next in order, namely, *Hylobates* (or of forms closely allied to this genus), have been found in the south of France (I allude to *Dryopithecus* and *Pliopithecus*), but the living representatives are now confined to Java, Assam, and Southern China.

Though the genera next in order, namely, those to which the Orang, the Gorilla, and the Chimpanzee belong, have not yet been discovered in fossil, a genus, different from all but more nearly allied to that of the chimpanzee, has recently yielded remains in the Siwalik hills of India. I refer to *Palæopithecus*, as described by Lydekker in Part XII of the " Records of the Geological Survey of India."

But though our palæontological evidence is meagre as to the place of origin and past distribution of the anthropoid apes, yet the fact that one genus, allied to *Hylobates*, has been proved to have existed in the south of Europe in Miocene times, and is now represented by the Gibbons in South-Eastern Asia and Java, while another genus more nearly allied to the chimpanzee of Western tropical Africa is proved to have lived in Northern India in Pliocene times,—these facts, I say, prove that a wave of anthropomorphic life existed from later Miocene to Pliocene times in the south of Europe and sub-tropical Asia.

The question next arises whether the genera of apes now existing have not been all derived from the south of Europe and sub-tropical Asia, as is proved to be the case with *Hylobates*. It is a most noteworthy fact that the whole of the existing genera of apes are equally divided between two regions so remote as Central Africa and Malaysia. It is a fact that indeed cannot be accounted for by supposing either of these regions to be a centre of ape-origin. Apes are too fond of the comforts of warmth and abundance of fruit to exchange without compulsion a tropical for a sub-tropical region. And this they would require to do if it were supposed that the apes of one of these regions were derived from the other region.[1] Again, the difference between the apes of Africa and those of Malaysia is too great to allow of the supposition that one set is derived from the other set. The supposition that Africa and Malaysia were each a separate centre of ape-evolution is too far-fetched for acceptance, seeing that the Oriental group is distinctly proved to have been derived from the south of Europe. The simplest inference, then, seems to be that all the genera of living apes are derived from Southern Europe and sub-tropical Asia.

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[1] The supposed lost continent underlying the Indian Ocean—*Lemuria*—is, for reasons given by Mr. A. R. Wallace, assumed to have had no existence.

But the lowest types of mankind are also found in the very regions where the anthropoid apes now exist. Our next question, then, is whether, on the assumption that man was evolved, he passed through the transition stage between ape and man in the tropics of Africa, or Malaysia, or in a latitude higher up?

Although many naturalists, and among them some of the most eminent, have regarded the present home of the anthropoid apes as the most probable region where man was evolved, and although I must confess that this was my own earlier belief, I must now dissent from this view for the following reasons:—

Firstly, the presence in the tropics of Africa and Malaysia of about equally inferior types of man, such as the Akka dwarfs in Africa, and the Aetas in Java—the former being characterised by prognathism most pronounced, and the latter by the most generally ape-like type of head and face—suggests derivation from a higher latitude as truly as does the presence in the same regions of the existing genera of anthropoid apes. In other words, just as apes existed in Europe and Asia before they reached the tropics, as is proved by palæontological facts, so we may infer that man existed in Europe and Asia before the low types referred to occupied tropical Africa and Malaysia. At least the presence in these latter regions of the low human races referred to need not suggest their origin in either Africa or Malaysia, any more than does the presence there of the anthropoid apes suggest their separate tropical origin.

Secondly, there is no evidence that the present habitat of the apes, regarded in its physical or geographical character, is such as to supply the forces necessary to evolve apes into manhood. The character of the habitat is too well suited to the wants of the ape to furnish any sufficient stimulus to its raising its status. We must look to some region where apes were compelled gradually to give up ape-habits of living in trees, and feeding on a mere fruit diet,—a region where apes were *compelled* to change their food and mode of locomotion, so as to develop more erect and elegant forms, with enlarged brains, and quickened intelligences,—a region forcibly subjecting them to lower temperature, and so making it possible for them ultimately to become universally distributed. No tropical region supplied the conditions necessary to produce such changes. In what direction, then, must we look?

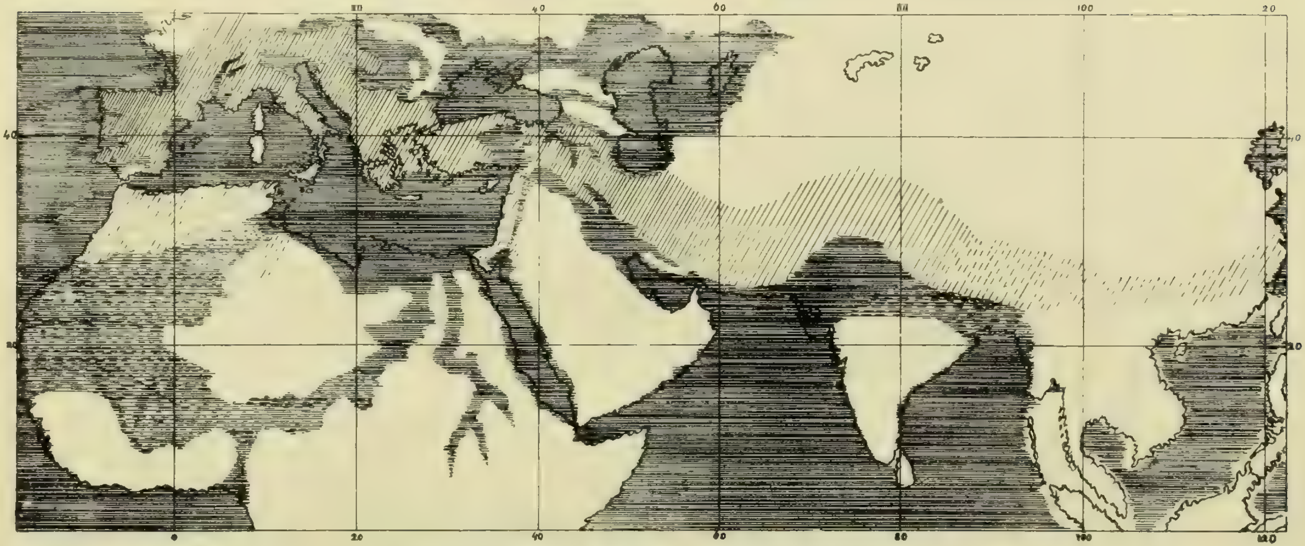
We have seen that it would be out of all reason, as far as present evidence goes, to suppose that the ape, out of which man sprang, was an inhabitant of America or of the Arctic regions. We have also seen that there is no evidence to show that apes existed farther north than Central Europe, and we have seen that they have been traced to Southern Europe and Northern India in Miocene and Pliocene times. In short, we have seen that there has been a gradual southward distribution of simian life, as of every other form of life, in consequence of the gradual cooling down of the northern zones of our globe.

The tendency of the steady process of refrigeration was of course to drive all forms of life, by degrees, southward to the tropics, excepting such as should become compulsorily adapted to temperate or cold climates; and had there been no barriers to this southward distribution in the Old World it is very probable that apes would never have had a fair chance of becoming evolved into manhood.

But geographical barriers did exist that were, on the one hand, unfavourable for apes moving southward, and so continuing to be apes, and on the other were favourable to their detention in the very region in which they had the best chance of becoming men, if they were to survive at all. What then were those barriers?

The principal barrier which prevented the apes from easily moving southwards was, briefly, the enormous extent of sea border on the south of Europe and sub-tropical Asia. On the south of Europe was the Mediterranean, separating Europe from Africa. On the south of sub-tropical Asia was the Arabian sea and its diverging branches, which in Miocene times extended from at least high up the Euphrates valley, down the Persian Gulf, round into the valley of the Indus and the Punjab. The Red Sea and Gulf of Suez, moreover, then ran into the Mediterranean. It is not impossible even that the Jordan valley was then filled with water, extending from the Red Sea to the Euphrates valley, thereby probably cutting off Arabia from Asia. It is not certain that, in Miocene times, what is now the Strait of Gibraltar was dry land, or that Europe was connected by an isthmus through Italy and Sicily to Africa. But allowing that land connections did exist, both between Gibraltar and Tangier, and between Italy and Tunis, yet there was still a water separation of some five thousand miles extent on its northern border between Europe and Africa, as compared with two bands, of fifty and a hundred miles respectively, of land

THE PROBABLE REGION OF MAN'S EVOLUTION.



EXPLANATORY-

Horizontal lines . . . . —The Sea Barrier in Late-Miocene times.

Oblique broken lines . —Region where Apes might have reached Tropics, and remained Apes.

Oblique unbroken lines—Region where Apes were arrested in southward migration, and developed into Men.

connection. Then, even if we admit that Arabia and India, as well as Malaysia, might have been reachable by similar narrow land routes, there was still a sea-barrier, of four to five thousand miles extent, cutting off the tropical from the sub-tropical regions of Asia.

Thus the Mediterranean Sea on the one hand, and the Arabian Sea, with its diverging branches up the Euphrates, Scinde, and Punjab valleys, on the other, proved immense sea-barriers, which must have arrested the southward migration of the anthropomorphous apes in Miocene and Pliocene times, preventing them from reaching the tropical regions of the Old World, so necessary to their comfort, and so well suited to their physical constitution.

Let us now inquire into the importance of this fact of a southern sea-barrier, together with attendant physical conditions on the future of anthropomorphic life.

The gradual southward dispersal of all forms of life was due to the approach of cold from the northern latitudes, distantly premonitory of a coming Ice Age. Impelled southwards by cold, and arrested by a southern sea-barrier, what must have been the effect upon the anthropoid apes of Southern Europe and sub-tropical Asia? Those apes that were near to the narrow land connections between Europe and Africa would of course escape (as far as to North Africa) from the effects of approaching cold; those similarly placed in Asia would be able to save themselves from like discomfort. *All the rest, however,—and they must have formed a vast majority*—who never knew of a possible way of escape, must have been obliged to remain and contend with adverse circumstances. First, they would have to contend with the conditions of a climate to which, for temperature, they had hitherto been unaccustomed. They had to become adapted to withstand a low temperature, and so develop one of the distinguishing characteristics of man, whereby he became universally distributed; or else they had to perish, as soon happens with apes brought from a tropical to a temperate region at the present day. Here, then, was the first struggle for existence, or for the development of one characteristic of man. Some, perhaps many, genera of apes died out in this struggle, but others doubtless were for a time successful, and were followed by a posterity still more successful. It must be remembered that this change from a warm to a temperate, or even cold climate, was gradual, and therefore admitted of adaptation more easily than at first sight might be imagined. Yet, doubtless, many genera died out, unable to protract the struggle. One thing seems very probable, namely, that the apes at present occupying the Equator are not likely to have been derived from the stock that were obliged to remain and contend with cold, but are more likely to be the descendants of those who were near the narrow land connections from Europe to Northern Africa, and from Asia down into Malaysia. The Ethiopian apes, however, are on the whole more highly developed than the Oriental ones, possibly on account of the long detention of their ancestors in the mountainous district of Northern Africa, arrested by the Sahara sea or desert.

The recently discovered Pliocene fossil, *Palæopithecus*, too, which has been shown by its teeth to be more highly developed than any existing Oriental ape, probably owed its superior development to its detention in the Himalayan region.

The same set of circumstances which drove the apes from Central to Southern Europe and Asia, and arrested their progress farther southwards (namely, on the north the increasing cold and on the south the sea-barrier), would operate upon immense hordes of other animals that had to contend with the same climatal hardships. The crowding together in this region of all kinds of animals must have given rise to other struggles, fiercer perhaps than those due to a lowering of temperature. In this region the struggle between natural enemies must have been intense, and was well calculated to sharpen intelligence, and promote the growth of brain. The apes, by nature endowed with imperfect powers of locomotion, would be compelled in self-defence to use their hands and arms in wielding weapons, instead of taking shelter in trees. Wood, horn, bone, and stone weapons or missiles would doubtless be used for such purposes with at first, perhaps, little care as to their suitability, and with no attempt at construction. But they doubtless played their part in training and educating the arms and hands of the improving ape.

The continued increase of cold would have another great result. By eliminating the number and extent of fruit-forests, the surviving apes would be compelled to adapt themselves gradually to new varieties of food. The compulsory departure from an exclusively fruit diet would probably be followed by the use of roots; or, in the neighbourhood of rivers, lakes, and seas, the apes would probably seek to secure a diet of mollusks, or of fish, or even now and then, perhaps, of stranded cetaceans. Is it not possible, then, that the man-like apes were by this means so far developed into ape-like men as to be intelligent enough to make for themselves implements of some kind, whereby they cut away the flesh of stranded whales, and left their ribs marked and notched (as Professor Capellini has found them) as a memento of this transition period of struggle? Whatever the apes of that time were obliged to live upon, it is certain they would in many cases have been obliged to change from a purely vegetarian diet.

But this necessity of resorting to search for other kinds of food would have the effect of shortening the upper limbs that had hitherto been so much applied to purposes of swinging from bough to bough in the luxuriant forests of fruit-trees. The upper limbs would shorten from the cessation of this habit: the hand would become developed into a more man-like organ of prehension. The lower limbs, on the other hand, would become stronger with exercise, and the foot, by frequent use, more adapted to support the body, and would more and more depart from the character of a prehensile organ.

But there is one other set of circumstances remaining to be considered, that must have greatly augmented the force of such conditions as I have described, and therefore have greatly increased the results I have shown, that must have flowed from them. It is this: the dry land in the south of Europe and sub-tropical Asia was steadily rising from the beginning of Miocene times, became gradually hilly, then mountainous, till eventually it became, as it is at the present day, "almost wholly a region of mountains and elevated plateaus." As the greater part of this district coincides with the south of the Palæarctic region or the Mediterranean sub-region in Mr. Wallace's "Geographical Distribution," and as that writer has given an admirable description of its present state, I cannot resist making the following extract:—"On the west, Spain is mainly a table-land of more than 2,000 feet elevation, deeply penetrated by extensive valleys, and rising into lofty mountain-chains. Italy, Corsica, Sardinia, and Sicily are all very mountainous, and much of their surface considerably elevated. Further east, we have all European Turkey and Greece, a mountain region with a comparatively small extent of level plain. In Asia the whole country from Smyrna, through Armenia and Persia, to the further borders of Affghanistan, is a vast mountainous plateau, almost all above 2,000 feet, and extensive districts above 5,000 feet in elevation. The only large tract of low-land is the valley of the Euphrates. There is also some low-land south of the Caucasus, and in Syria the valley of the Jordan. In North Africa, the valley of the Nile, and the coast plains of Tripoli and Algiers, are almost the only exceptions to the more or less mountainous and plateau-like character of the country" (pp. 199, 200).

The more eastward part of sub-tropical Asia, namely, the north and north-east of India, is so well known to be mountainous that it needs no description.

Now, in order to prove that the whole of this district of Southern Europe and sub-tropical Asia has been gradually raised during Tertiary time, I give a short extract from Sir Charles Lyell's "Elements of Geology":—

"The nummulitic limestone [which I need hardly say is of Eocene date] of the Swiss Alps rises to more than 10,000 feet above the level of the sea, and attains here and in other mountain-chains a thickness of several thousand feet. It may be said to play a far more important part than any other tertiary group in the solid framework of the earth's crust, whether in Europe, Asia, or Africa. It occurs in Algeria and Morocco, and has been traced from Egypt (where it was largely quarried of old for building the Pyramids) into Asia Minor and across Persia by Bagdad to the mouths of the Indus. It has been observed not only in Cutch but in the mountain-ranges which separate Scinde from Persia, and which form the leading passes into Cabul; and it has been followed still farther eastward into India as far as Eastern Bengal and the frontiers of China." Further, "Dr. Thomson found nummulites in Western Thibet at an elevation of 16,500 feet." Again, summarising the facts, he says: "All the mountain-chains, such as the Alps, Pyrenees, Carpathians, and Himalayas, into the composition of whose loftier parts the nummulitic strata enter bodily, could have had no existence till after the middle Eocene period. During that period the sea prevailed where these chains now rise" (pp. 260–1).

Since elevation has never taken place suddenly, it follows that from the beginning of Miocene times these mountains and plateaus have gradually risen, through the Miocene and Pliocene epochs, till at last they attained their present elevation. The fact of their gradual and not sudden elevation is marked by the known deposits of Miocene and Pliocene age on the flanks and bases of mountain-ranges of the Pyrenees, the Caucasus, the Himalayas, as well as the mountain-ranges of Italy, and also in Greece. Now it was in later Miocene and in Pliocene times that the family of anthropoid apes occupied this region, and were, along with hordes of other animals, endeavouring to become adapted to the lower temperature which was stealing upon them gradually from the north. As time went on, the increase of cold, which proceeded from the refrigerating causes that culminated in the last glacial epoch, had *added to it* the increase of cold due to gradual elevation of the land in this extensive zone. The effect of gradual elevation would manifestly be to greatly augment the changes of structure, habit, and character of those apes that were able to keep up the struggle. These changes, as I have already said, would be—first, a hardened power of contending with cold; the acquisition of habits of living on varied food; of using weapons of self-defence, and so improving the hand; of abandoning the forest-life, and so improving the powers of locomotion and proportioning the lower to the upper limbs as in man; growth of brain by virtue of the stimulus afforded by all the factors in this long-protracted struggle. And to all this I add yet farther that the mountainous character of the region perfected the human characteristics of an erect posture—curving the spine forward in the lumbar region, and widening the pelvis as the result of action in ascending and descending the mountain sides.

Having completed my argument as respects the region of Man's evolution, I am bold to repeat that the due consideration of the geographical, climatal, and other conditions of this southern portion of the Palæarctic Region upon the anthropoid apes which occupied it in later Miocene and Pliocene times, taken in connection with the facts of distribution of the higher *Primates*, must lead to the conclusion that this region was of all others the most likely to have supplied the conditions necessary to the evolution of the bimanous erect and large-brained form of Man out of the quadrumanous semi-erect and small-brained form of the Ape.

One word, in conclusion, with respect to the practicability of discovering those remains which my argument goes to show lie entombed in strata of the south of the Palæarctic Region.

I have already quoted authorities to prove that the whole of this zone had undergone a process of gradual and continuous upheaval during Tertiary time. The lowest of the Tertiary strata, in point of actual altitude, namely, the Eocene, is found at heights from 10,000 to 17,000 feet above sea-level. Since upheaval must at all times be gradual it follows that the continuous rising of the land into what are now lofty mountain-ranges would have the effect of tilting the various layers of strata deposited through Miocene and Pliocene times.

The inclination of these strata, therefore, gives us every encouragement to believe in the accessibility of the remains of which we are in quest. Though there is yet much to learn about the geology of the south of the Palæarctic Region there is even now abundance of information to guide exploration. Unfortunately, perhaps, for *us* most of this extensive region is under other than British rule, else we might prosecute inquiries in the Pyrenees or the Caucasus, or in some of the promising districts of Italy. Our protectorate of Asia Minor, however, might enable us to obtain leave of the Turkish Government to explore any portion of that country that might be deemed fruitful of search. Having retired from Afghanistan we need not indulge the hope of soon exploring that country. But there is India at our command. According to evidence confirmed by the Records of the Geological Survey of India, Miocene and Pliocene deposits occupy the northern border of the Punjab, the western border of Scinde, and the mountain-range between India and Burmah. In exploring for the remains of pithecoid man it is of course necessary to confine our search to deposits of fresh-water or brackish water origin. In marine deposits we of course would search in vain. Moreover, it would be advisable to limit our search, even among fresh-water strata, to such as gave promise of good preservation of osseous remains. Matters such as these, however, constitute details that would be sure to receive the attention of any earnest investigator.

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The remainder of the paper was devoted to the advocacy of a Committee of Exploration being formed out of the members of the Anthropological Institute to prosecute or direct investigation in view of discovering the fossil remains which are required to place the doctrine of Man's Evolution beyond question.

The discussion which followed was in no part adverse to the arguments brought forward in the paper. And though the practical following up of the suggestion to form a special Committee of Exploration was not agreed upon, on the ground—as was observed by the Chairman—"that the whole Institute is a standing committee for the collection of anthropological information," yet I still hope that my suggestion may eventually be adopted, as I feel assured that research of such a kind would be best directed by a small but well chosen committee.

Harrison and Sons, Printers in Ordinary to Her Majesty, St. Martin's Lane.

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